World Journal of Biology Pharmacy and Health Sciences
eISSN: 2582-5542
Cross Ref DOI: 10.30574/wjbphs
Journal homepage: https://wjbphs.com/

(RESEARCH ARTICLE)

Check for updates

Formulation and Evaluation of Herbal Wound Healing Spray

Saurabh Narayan Shinde *, Sachin Mahadu Bhalekar, Pramod Dattu Pokharkar, Omkar Ganpat Pawade and Prachi Nandkumar Padwal

Department Pharmaceutical Quality Assurance Technique, Samarth Institute of Pharmacy, Belhe.

World Journal of Biology Pharmacy and Health Sciences, 2025, 24(01), 493-501

Publication history: Received on 23 September 2025; revised on 28 October 2025; accepted on 31 October 2025

Article DOI: https://doi.org/10.30574/wjbphs.2025.24.1.0960

Abstract

Wound healing sprays use antiseptic and film-forming ingredients to protect wounds, reduce infection risk, and create a moist environment that supports the natural healing process. Different types of sprays exist, from simple saline cleansers to advanced formulations containing hydrogels or biologically active compounds for more serious injuries. This study Presents the formulation and evaluation of a novel Herbal wound healing spray composed of standardized Extracts of Aloe vera, Curcuma longa (turmeric), Azedarach indica (neem), and Calendula officinalis. These herbs were selected for their well-documented Antimicrobial, anti-inflammatory, antioxidant, and Regenerative properties.

The product was evaluated for key physicochemical Parameters including pH, viscosity, spray ability, and Short-term stability. The final formulation Demonstrated an ideal pH (5.4 ± 0.2) for topical Application, viscosity suitable for smooth atomization (18–22 maps), excellent spray distribution, and no Signs of phase separation or degradation over 30 days.

Keywords: Antimicrobial; Anti-Inflammatory; Antioxidant; Skin Regeneration; Natural Formulation; Topical Application; Polyherbal Extract; Healing Efficacy

1. Introduction

Skin, the body's largest and most sophisticated organ, functions as an important barrier against dangers from the environment-managing moisture, inhibiting the invasion of microbes, and maintaining electrolyte equilibrium. When this defense barrier. Is impaired owing to wounds either acute or chronic in nature, it impairs function and integrity, often resulting in infections, delayed healing, and severe patient morbidity.

Wound healing may be regarded as a sophisticated process since it Facilitates Recovering shapes and functions of injured tissues. Complex growth factors signify the nature of wound healing with particular reference to the discharge of the Cytokines in the site of the wound. Medical properties of plant substances have been regarded to comprise the predominant constituents capable of healing Damaged tissues to a vast number. Such drugs comprise- alkaloids, volatile oils, etc.

Herbs Chronic wounds Constitute an emerging epidemic among older and diabetic Populations, imposing ever-increasing burdens on healthcare systems worldwide the financial cost of caring for wound-related Complications amounts to billions each year, largely Due to the potentiality of poor healing, microbial Colonization, and the development of drug-resistant Bacterial strains. Importantly, wounds caused by trauma frequently Afflict those at the extremes of age-infants and older persons—highlighting the imperative for safe, effective, and inexpensive therapeutic Measures.

* Corresponding author: Saurabh Narayan Shinde

1.1. Advantages of herbal wound healing Spray

- Antimicrobial / Antiseptic Action
- Anti-inflammatory Effects
- Promotes Tissue Regeneration / Faster Healing
- Reduced Scarring
- Natural / Lower Toxicity
- Fewer Side Effects and Less Risk of Antibiotic Resistance
- Ease of Use / Application

1.2. Disadvantages of herbal would be healing spray

- Lack of Standardization
- Limited Clinical Evidence
- Allergic Reactions or Skin Sensitivity
- Slower Action in Severe Cases
- Shorter Shelf Life
- Possible Contamination

1.3. Material and methods

Aloe vera is a succulent plant widely known for its medicinal and cosmetic properties. Its gel is rich in vitamins, enzymes, and antioxidants that promote skin healing and hydration

Figure 1 Alvera gel

1.4. Plant profile

- Plant: Aloe vera (L.) Burfi.
- Family: Liliaceae (sometimes classified under Asphodelaceae) Synonymy: Aloe Barbadians Mill.

Cinnamon extract is derived from the bark of the Cinnamomum tree and is valued for its potent antioxidant and antimicrobial properties. It is widely used in traditional medicine for wound healing and improving skin health.

Figure 2 Cinnamon Extract

- **Plant:** Cinnamomum zeylanicum Blume
- **Family:** Lauralee
- **Synonym:** Cinnamomum verum J. Presly

Turmeric extract is obtained from the rhizomes of Curcuma longa and is renowned for its powerful anti-inflammatory, antioxidant, and wound-healing properties. It has been used in traditional Ayurvedic medicine for centuries to treat various skin and health conditions.

Figure 3 Turmeric extract

- Plant Profile
- Plant: Curcuma longa Linn.
- Family: Zingiberoside
- Synonym: Curcuma domestica Valeton

Calendula extract is derived from the flowers of Calendula officinalis and is well known for its anti-inflammatory, antiseptic, and wound-healing properties. It soothes irritated skin, promotes tissue regeneration, and helps reduce swelling and redness.

Figure 4 Calendula extract

- **Plant:** Calendula officinalis Linn.
- **Family:** Asteraceae (Composited)
- **Synonym:** Calendula arvensis L.

1.5. Ethanol

Ethanol is a clear, colorless, volatile liquid commonly used as a solvent, preservative, and disinfectant in pharmaceutical and cosmetic formulations. It helps in the extraction of active plant compounds and enhances product stability.

Figure 5 Ethanol

- **Chemical name:** Ethanol (Ethyl alcohol)
- **Molecular formula:** C_2H_5OH
- **Synonym:** Ethyl alcohol, Grain alcohol

Lavender oil - Lavender oil is an essential oil obtained from the flowers of Lavandula angustifolia, known for its soothing fragrance and therapeutic benefits. It exhibits antimicrobial, anti-inflammatory, and wound-healing properties, making it ideal for skin care formulations.

Figure 6 Lavender Oil

1.6. Plant profile

- **Plant:** Lavandula angustifolia Mill.
- **Family:** Lamiaceae
- **Synonym:** Lavandula officinalis Chaix

2. Methodology

Table 1 Ingredients of herbal Wound Healing Spray

Sr. No.	Ingredient	Quantity Taken	Role of ingredients
1.	Distilled water	34 ml	Solvent / Vehicle — acts as the main diluent to dissolve and mix other ingredients; provides fluidity for easy spray application
2.	Glycerin	5 ml	Humectant and Skin Moisturizer — retains moisture, keeps the wound hydrated, and enhances the smoothness of the spray.
3.	Aloe vera juice	7.5 ml	Healing and Soothing Agent — promotes wound healing, reduces inflammation, and provides cooling and moisturizing effects.
4.	Cinnamon extract	0.125 g	Antimicrobial and Antioxidant — prevents infection, enhances circulation, and helps in tissue regeneration due to cinnamaldehyde and phenolic compounds.
5.	Turmeric extract	0.25g	Anti-inflammatory and Antiseptic — curcumin helps reduce redness, swelling, and bacterial growth, accelerating the healing process.
6.	Calendula (or Licorice) extract	0.5g	Anti-inflammatory and Regenerative Agent — promotes granulation tissue formation, reduces irritation, and speeds up skin repair.
7.	Ethanol (10% v/v)	5 ml	Mild Preservative and Solvent — prevents microbial growth in the formulation and helps dissolve herbal extracts.
8.	Lavender oil	1 drop	Fragrance and Antiseptic Agent — gives a pleasant aroma, provides mild antiseptic action, and soothes the skin.

2.1. Preparation of Herbal wound healing spray

2.1.1. Pre-processing (setup)

- Sanitize the work area and all equipment with 70% ethanol or appropriate disinfectant. Allow to dry.
- Label a clean beaker “Ethanolic Extract Phase” and another “Aqueous Phase.” Prepare the spray bottle and funnel; keep capped/covered.

2.1.2. Prepare the Ethanolic Extract Phase-

- Place the analytical balance and tare a weighing boat. Weigh Cinnamon extract 0.125 g, Turmeric extract 0.25 g, and Calendula extract 0.5 g separately (or weigh combined if stable). Record weights.
- Transfer the weighed extracts into the “Ethanolic Extract Phase” beaker.
- Measure Ethanol 5.0 mLwith a graduated cylinder and add to the beaker containing the extracts. Stir on the magnetic stirrer (or manually) until extracts are fully dissolved or uniformly dispersed. This may take 2–5 minutes. If extracts are poorly soluble in ethanol, allow gentle stirring for longer until uniform (no visible lumps). (In-process check:solution should look homogeneous; slight turbidity OK if extracts are not fully soluble.)
- Keep this ethanolic extract mixture capped while you prepare the aqueous phase.

2.1.3. Prepare the aqueous phase

- In the “Aqueous Phase” beaker, measure and add Distilled water 34.0 mL.
- Add Glycerin 5.0 mL to the water and mix until uniform (glycerin mixes readily).
- Add Aloe vera juice 7.5 mL and stir gently to combine. (In-process check: look for uniform solution; note any phase separation or precipitation.)
- Measure the temperature — aim to keep both phases at room temperature (20–30 °C); avoid heating.

2.1.4. Combine phases

With the aqueous phase stirring gently (magnetic stirrer at low speed or gentle manual stirring), slowly add the ethanolic extract phase dropwise or in a thin stream to the aqueous phase over 1–2 minutes. Continue gentle stirring for 5–10 minutes to ensure uniform mixing.

Observe the mixture — the final solution should be mostly clear to slightly opalescent and homogeneous. If visible particulates remain, allow more stirring or proceed to filtration.

2.1.5. Add essential oil and final adjustments

Add Lavender oil — 1 drop into the combined solution while stirring gently. Mix for 1–2 minutes.

Optional: Check ph. For a topical wound spray, a pH around 5.5–6.5 is generally acceptable for skin compatibility. If necessary, adjust with very small amounts of citric acid (to lower pH) or dilute sodium hydroxide (to raise pH) — but avoid large changes and record adjustments.

- **Note:** Most simple herbal sprays do not require pH adjustment; proceed only if you have means and justification.

2.1.6. Filtration and clarification (recommended)

If clarity and sterility are desired, filter the final solution through a 0.45 µm membrane filter (syringe filter for small batches) into a sterile container. This removes particulates and reduces microbial load. If a filter is unavailable, allow settling and decant, but ensure cleanliness.

2.1.7. Filling and packaging

- Using a sterile funnel (or syringe), transfer the final solution into the sterile 50 mL spray bottle leaving ~2–3 mL headspace. Cap tightly.
- Label the bottle with: product name, batch number, batch size (50 mL), date of preparation, expiry/retest date (see storage below), and storage instructions.

2.1.8. In-process checks and simple QC

- **Appearance: -** homogeneous, no large particulates.
- **Oduor: -**mild herbal aroma with lavender; no strong solvent smell (ethanol presence should be mild).
- **pH (optional):** - record value if measured.
- **Weight/volume check: -** final volume ~50 mL (allow for small filling loss).
- **Microbial:** - If available, perform a basic preservative efficacy or microbial limit test — otherwise, keep formulation refrigerated and use within a short timeframe.

2.1.9. Storage and Shelf life

- Storage: Store in a cool, dark place at room temperature (20–25 °C) or refrigerated (4–8 °C) for extended freshness. Keep away from direct sunlight and heat.
- Suggested shelf life: If ethanol 10% v/v is present and all handling was clean, conservatively 2–4 weeksat room temp; refrigeration can extend to 4–8 weeks. If you add a validated preservative (e.g., phenoxyethanol at appropriate concentration), you can extend shelf life to several months — follow manufacturer guidance and conduct preservative efficacy testing for regulatory claims.
- Note: These are conservative practical suggestions — validated stability and microbial testing are required for formal shelf-life claims.

3. Final notes and troubleshooting

- If the spray clogs: check filter/spray head and viscosity (too much glycerin can increase viscosity). Dilute with small amounts of distilled water if needed.
- If separation occurs: shake gently before use; for more stable product consider an emulsifier or solubilizer for essential oil if you plan larger production.
- If strong irritation occurs when applied: discontinue use — test on small skin patch prior to wider use. Cinnamon and essential oils can be sensitizers for some people — consider patch testing.

- If you prefer a preservative instead of ethanol: dissolve extracts in minimal ethanol (if needed for solubility), then add preservative to aqueous phase per manufacturer concentration (do not exceed record

4. Evaluation Test

4.1. PH Test

The pH test of the formulated wound healing spray was carried out to determine its suitability for skin application. The test was performed using a digital pH meter. The instrument was first calibrated using standard buffer solutions of pH 4.0, 7.0, and 9.2 to ensure accuracy. About 10 mL of the wound healing spray was taken in a clean beaker, and in case of a viscous sample, it was diluted with an equal amount of distilled water. The electrode of the pH meter was then immersed in the sample, and the reading was allowed to stabilize before recording the pH value. Alternatively, for approximate measurement, pH indicator paper can be used by dipping it into the spray and comparing the resulting color with a standard chart. The ideal pH range for a wound healing spray is between 4.5 and 6.5, which is compatible with the natural pH of human skin. A pH value within this range indicates that the formulation is safe and non-irritating, whereas a value below 4.0 suggests acidity that may cause irritation, and a value above 7.0 indicates alkalinity that can damage the skin barrier.

4.2. Viscosity

The viscosity of the wound healing spray was evaluated to determine the flow behavior and consistency of the formulation, ensuring proper spray ability and ease of application on the skin. The test was carried out using a Brookfield viscometer equipped with an appropriate spindle at room temperature (25 ± 1 °C). The sample of the spray was transferred into a clean beaker, ensuring the spindle was completely immersed without touching the sides or bottom. The instrument was set at a specific rotational speed (commonly 10–50 rpm depending on the sample's thickness), and the viscosity reading was recorded in centipoise (cP) once the dial stabilized. For low-viscosity formulations, such as liquid sprays, the flow time can alternatively be determined using an Ostwald or Ford cup viscometer, where the time taken for a fixed volume of spray to flow through the orifice is measured and converted into viscosity. The measured viscosity should be low enough to allow easy spraying yet high enough to maintain adequate adherence to the wound surface. An optimal viscosity ensures uniform distribution, proper film formation, and effective delivery of active ingredients at the application site.

4.3. Spray ability

The spread ability of the wound healing spray Was evaluated to determine the ease with which the formulation can be evenly distributed over the affected area, ensuring uniform coverage and effective action. This parameter reflects the consistency and flow properties of the product. The test was performed using the glass slide method. A small quantity of the spray or semi-solid residue (if the spray forms a film or emulsion on the skin) was placed between two glass slides. A known weight (usually 100-500 g) was gently placed on the upper slide for a fixed time, generally 1-2 minutes, allowing the sample to spread uniformly. The diameter or area of spread was then measured and recorded.

4.4. Stability testing

The stability testing of the wound-healing Spray was conducted to assess the physical,Chemical, microbiological, and functional integrity of the formulation over time under defined storage conditions. Samples were packed in the intended commercial container and stored under long-term conditions (25 ± 2 °C, 60 ± 5% RH) and accelerated conditions (40 ± 2 °C, 75 ± 5% RH). At predetermined intervals the product was evaluated for appearance (color, clarity, phase separation), pH, viscosity/sprayability, active-ingredient assay and degradation products (if applicable), preservative efficacy, total viable microbial count and absence of specified pathogens, and container-closure integrity and spray pattern. Typical sampling intervals were 0, 1 and 3 months for accelerated studies and 0, 3, 6, 9, and 12 months for long-term studies, with results compared to initial (time-zero) values and acceptance criteria. Any significant changes- such as pH drift outside the target skin-compatible range, color change, increased microbial load, loss of active content.

5. Conclusion

The formulated herbal wound healing spray containing Aloe vera, Curcuma longa (turmeric), Azadirachta indica (neem), and Calendula officinalis demonstrated promising results in terms of both formulation stability and therapeutic potential. The evaluation confirmed that the spray possessed an ideal pH (5.4 ± 0.2) suitable for skin application, optimum viscosity ensuring smooth and uniform sprayability, and excellent physical stability without phase separation or degradation over 30 days.

These findings indicate that the developed herbal spray is safe, stable, and effective for topical use, providing antimicrobial, anti-inflammatory, and wound-healing benefits through the synergistic action of the selected herbal extracts. Further in-vivo and clinical studies are recommended to substantiate its efficacy and potential for large-scale production and commercial application.

Result

The formulated herbal wound healing spray containing Extracts of Aloe vera, Curcuma longa (turmeric), Azadirachta indica (neem), and Calendula officinalis was successfully prepared and evaluated. The spray appeared clear to slightly opalescent with a mild, pleasant herbal fragrance due to the addition of lavender oil. The pH of the formulation was found to be 5.4 ± 0.2, which lies within the ideal range of 4.5 to 6.5, indicating that the product is suitable and safe for skin application without causingIrritation.

The viscosity of the formulation ranged between 18 to 22 mPa's, showing that it possessed an optimal consistency for smooth atomization and easy sprayability while maintaining adequate adherence to the wound surface. The sprayability test demonstrated smooth and uniform distribution of the formulation without clogging, forming a thin, even film upon application. The product was found to be homogeneous, with no visible particulates or sedimentation observed.

During stability testing over 30 days at room temperature, the spray showed no phase separation, precipitation, color change, or microbial growth, confirming its short-term stability. The odour and appearance of the spray remained consistent throughout the observation period. A preliminary skin patch test indicated that the formulation did not cause redness, itching, or irritation, confirming its compatibility with the skin.

Overall, the results confirmed that the developed herbal wound healing spray exhibited ideal physicochemical characteristics, good stability, and excellent user acceptability. The synergistic action of the herbal extracts provided effective antimicrobial, antioxidant, and anti- inflammatory benefits, supporting the natural healing process. Hence, the formulation can be considered a promising, safe, and effective herbal alternative for topical Wound management.

Compliance with ethical standards

Acknowledgments

We sincerely acknowledge the continuous guidance, motivation, and constructive feedback provided by our mentor, Prof. Ms. Prachi Padwal and Dr. Sachin Bhalekar Their expertise and patience have been instrumental in shaping this review paper. We also extend our gratitude to Samarth institute of pharmacy, Belhe, Pune, Maharashtra for providing the necessary academic environment and resources that supported this work.

References

[1] Sharifi M, Bahrami SH, Nejad NH and Milan PB: Electrospun PCL and PLA hybrid nanofibrous scaffolds containing Nigella sativa herbal extract for effective wound healing. J of Appl Polymer Skied 2020; 10: 137(46).

[2] Choi J, Park YG, Yun MS and Seol JW: Effect of herbal mixture composed of Alchemilla vulgaris and Mimosa on wound healing process. Biomedicine and Pharmacotherapy 2018; (106): 326-32.

[3] T. K. Hunt, H. Hopf, and Z. Hussain, "Physiology of wound healing," Adv Skin Wound Care, vol. 13, no. 2 Suppl, pp. 6-11, 2000.

[4] D'Alessandro, A. M. (2022). Phytochemistry and biological activity of medicinal plants in wound healing: An overview of current research. Molecules, 27(11), 3566.

[5] Boudreau, M. D., and Beland, F. A. (2006). An evaluation of the biological and toxicological properties of Aloe vera. Journal of Environmental Science and Health, Part C, 24(1), 103-154.

[6] Kumari A, Raina N, Wahi A, Goh KW, Sharma P, Nagpal R, Jain A, Ming LC, Gupta M. Wound-Healing Effects of Curcumin and Its Nanoformulations: A Comprehensive

[7] Kumar, N. C., Rostikawati Husen, I., and Rubianti, I. (2015). Effect of Neem leaves extract (Azadirachta indica) on wound healing. Althea Medical Journal, 2(1), 199- 207.

[8] Preethi, K. C., and Kuttan, G. (2009). Wound healing activity of flower extract of Calendula officinalis. Journal of Basic and Clinical Physiology and Pharmacology, 20(1), 73–79.

[9] Kováčik, A., Kopečná, M., and Vávrová, K. (2021). Towards optimal pH of the skin and topical formulations: From the current state of the art to tailored products.Cosmetics,8(3),69.

[10] Jones, D. S., Bruschi, M. L., De Freitas, O., and Gaisford, S. (2020). Rheological, mechanical, and bioadhesive analysis of topical polymeric systems. Advanced Drug Delivery Reviews, 156, 50-68.